

## What is Claimed Is:

1. A method of producing glycosylated pilin comprising:  
 introducing a vector containing genes encoding an O-antigen of a  
 Gram-negative bacterium into a strain of *Pseudomonas aeruginosa* containing the  
 5 *pilO* gene, such that said O-antigen is expressed in said *Pseudomonas aeruginosa* and  
 said pilin is glycosylated with said O-antigen of said Gram-negative bacterium; and  
 isolating said glycosylated pilin.
2. A method of producing glycosylated pilin comprising:  
 10 introducing a vector containing genes encoding an O-antigen of a  
 Gram-negative bacterium into strain 1244 of *Pseudomonas aeruginosa*, such that said  
 O-antigen is expressed and strain 1244 pilin is glycosylated with said O-antigen of  
 said Gram-negative bacterium; and  
 isolating said glycosylated pilin.
- 15 3. A method of producing glycosylated pilin comprising:  
 introducing a vector containing genes encoding the O-antigen of  
*Escherichia coli* into strain 1244 of *Pseudomonas aeruginosa*, such that the O-antigen  
 is expressed and strain 1244 pilin is glycosylated with said O-antigen of said  
*Escherichia coli*; and  
 20 isolating said glycosylated pilin.
4. A method of producing glycosylated pilin comprising:  
 introducing a vector containing genes encoding the O-antigen of strain  
 011 of *Pseudomonas aeruginosa* into strain 1244 of *Pseudomonas aeruginosa*, such  
 that the O-antigen is expressed and strain 1244 pilin is glycosylated with said O-  
 25 antigen of strain 011 of *Pseudomonas aeruginosa*; and  
 isolating said glycosylated pilin.
5. A method of eliciting an immune response against a Gram-  
 negative bacterial infection in a vertebrate animal comprising:  
 introducing a vector containing genes encoding the O-antigen of a  
 30 Gram-negative bacterium into a strain of *Pseudomonas aeruginosa* containing the

*pilO* gene such that the O-antigen is expressed in said *Pseudomonas aeruginosa* and said pilin is glycosylated with said O-antigen of said Gram-negative bacterium; isolating said glycosylated pilin; and administering said glycosylated pilin to said vertebrate animal, in a pharmaceutically suitable carrier.

6. The method of Claim 5, wherein said strain of *P. aeruginosa* is strain 1244.

7. The method of Claim 5, wherein said Gram-negative bacterium is *E. coli*.

8. The method of Claim 5, wherein said Gram-negative bacterium is *P. aeruginosa* strain 011.

9. The method of Claim 5, further comprising isolating antibodies produced in response to administration of said glycosylated pilin in said vertebrate animals.

10. The method of Claim 9, further comprising administering said antibodies to a vertebrate animal suffering from said Gram-negative bacterial infection, to provide passive immunity against said infection.

11. The method of Claim 9, further comprising:

(a) contacting a sample from a vertebrate animal thought to have a Gram-negative bacterial infection with said antibodies; and

(b) detecting the presence or absence of said Gram-negative bacterial infection by detecting the presence or absence of a complex formed between said O-antigen and said antibodies specific therefore.

12. The method of Claim 1, further comprising:

(a) contacting a sample from a vertebrate animal thought to have a Gram-negative bacterial infection with said glycosylated pilin; and

(b) detecting the presence or absence of said Gram-negative bacterial infection by detecting the presence or absence of a complex formed between said glycosylated pilin and antibodies specific therefore in said sample.

13. A composition for eliciting an immune response in a vertebrate animal comprising glycosylated pilin in a pharmaceutically acceptable carrier, said glycosylated pilin containing an O-antigen derived from a Gram-negative bacterium which is not a strain of *Pseudomonas aeruginosa* containing the *pilO* gene.

14. A method of eliciting an immune response in a vertebrate animal having an infection from a Gram-negative bacteria comprising: administering glycosylated pilin to said vertebrate animal in a pharmaceutically acceptable carrier,

said glycosylated pilin containing an O-antigen derived from a Gram-negative bacterium which is not a strain of *Pseudomonas aeruginosa* containing the *pilO* gene.

15. A method of isolating an aminoglycan from glycosylated pilin comprising mixing said glycosylated pilin with proteolytic enzymes for an amount of time sufficient to provide complete proteolysis of said aminoglycan from the pilin protein, and purifying said aminoglycan.

16. The method of claim 15, further comprising covalently attaching said aminoglycan to a carrier protein, to produce an aminoglycan-carrier protein conjugate.

17. The method of Claim 16, wherein said carrier protein is selected from the group consisting of ovalbumin, pili, keyhole limpet hemocyanin and exotoxin A toxoid.

18. The method of Claim 15, further comprising mixing said isolated aminoglycans from more than one Gram-negative bacteria and covalently attaching said mixed aminoglycans to a carrier protein, to produce a mixed aminoglycan-carrier protein conjugate.

19. The method of Claim 18, wherein said carrier protein is selected from the group consisting of ovalbumin, pili, keyhole limpet hemocyanin and exotoxin A toxoid.

20. The method of Claim 15, further comprising:

(a) contacting a sample from a vertebrate animal thought to have a Gram-negative bacterial infection with said isolated aminoglycan; and

(b) detecting the presence or absence of said Gram-negative bacterial infection by detecting the presence or absence of a complex formed between  
5 said aminoglycan and antibodies specific therefore in said sample.

21. A method of eliciting an immune response in a vertebrate animal having an infection from a Gram-negative bacteria comprising:

administering the aminoglycan-carrier protein conjugate of Claim 16 to a vertebrate animal in a pharmaceutically acceptable carrier.

10 22. The method of Claim 21, further comprising isolating antibodies produced in response to administration of said aminoglycan-carrier protein conjugate in said vertebrate animal.

23. The method of Claim 22, further comprising administering said antibodies to a vertebrate animal suffering from said Gram-negative bacterial  
15 infection, to provide passive immunity against said infection.

24. The method of Claim 22, further comprising:

(a) contacting a sample from a vertebrate animal thought to have a Gram-negative bacterial infection with said antibodies; and

(b) detecting the presence or absence of said Gram-negative bacterial infection by detecting the presence or absence of a complex formed between  
20 an O-antigen of said Gram-negative bacteria and said antibodies specific therefore.

25. A method of eliciting an immune response in a vertebrate animal having an infection from a Gram-negative bacteria comprising:

administering the mixed aminoglycan-carrier protein conjugate of  
25 Claim 18 to a vertebrate animal in a pharmaceutically acceptable carrier.

26. The method of Claim 25, further comprising isolating antibodies produced in response to administration of said mixed aminoglycan-carrier protein conjugate in said vertebrate animal.

27. The method of Claim 26, further comprising administering said  
30 antibodies to a vertebrate animal suffering from said Gram-negative bacterial infection, to provide passive immunity against said infection.

28. The method of Claim 5, wherein said immune response is protective.

29. The method of Claim 14, wherein said immune response is protective.

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